

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) An optical scanning device for scanning optical record carriers having information layers at different information layer depths within the carrier, the optical record carriers including a first optical record carrier ~~(3')~~ having an information layer ~~(2')~~ at a first information layer depth d_1 , a second optical record carrier ~~(3'')~~ having an information layer ~~(2'')~~ at a second information layer depth d_2 and a third optical record carrier ~~(3''')~~ having an information layer ~~(2''')~~ at a third information layer depth d_3 , wherein $d_3 < d_2 < d_1$,

the scanning device including a radiation source system ~~(7)~~ for producing first, second and third radiation beams ~~(4'; 4''; 4''')~~, for scanning said first, second and third record carriers

~~(3', 3'', 3''')~~, respectively, the device including a diffraction structure ~~(48)~~ introducing first, second and third, different, wavefront modifications into at least part of the first, second and third, radiation beams, respectively,

the diffraction structure being arranged to operate at selected diffraction orders m_1 , m_2 , m_3 , for the first, second and third radiation beams, respectively,

wherein at least one of the selected diffraction orders m_1 , m_2 , m_3 is negative, and

~~characterised in that~~ wherein the diffraction structure is arranged such that the following relation holds:

$$-1 < \frac{(m_3 - m_2)}{(m_2 - m_1)} - \frac{(d_3 - d_2)}{(d_2 - d_1)} < 1.$$

2. (Currently Amended) ~~An~~ The optical scanning device according to claim 1, wherein the diffraction structure ~~(48)~~ is arranged such that the following relation holds:

$$-\frac{1}{2} < \frac{(m_3 - m_2)}{(m_2 - m_1)} - \frac{(d_3 - d_2)}{(d_2 - d_1)} < \frac{1}{2}.$$

3. (Currently Amended) ~~An~~ The optical scanning device according to claim 1, wherein said optical scanning device has an optical axis ~~(OA)~~ and said diffraction structure ~~(48)~~ comprises a plurality of annular protrusions ~~(50)~~ arranged concentrically about said optical axis.

4. (Currently Amended) ~~An~~ The optical scanning device according to claim 1, wherein each said protrusion ~~(50)~~ has a stepped profile, each protrusion including a plurality of steps having different heights ~~(h_1 , h_2 , h_3)~~.

5. (Currently Amended) ~~An~~ The optical scanning device according to claim 1, wherein said optical scanning device comprises an adaptation structure ~~(40)~~ arranged to introduce a non-diffraction adaptation component into each radiation beam, wherein said adaptation component is arranged to introduce spherical aberration.

6. (Currently Amended) ~~An~~ The optical scanning device

according to claim 5, wherein said adaptation structure provides a face ~~(46)~~ which is substantially aspherical.

7. (Currently Amended) ~~An~~ The optical scanning device according to claim 5, wherein said diffraction structure ~~(48)~~ is combined with said adaptation structure ~~(40)~~.

8. (Currently Amended) ~~An~~ The optical scanning device according to claim 1, wherein said optical scanning device has an optical axis ~~(OA)~~ and comprises a non-periodic phase structure arranged to introduce a non-periodic phase component into each radiation beam, wherein said non-periodic phase structure comprises a plurality of radial zones ~~(114, 116, 118)~~ arranged concentrically about said optical axis ~~(OA)~~ and having a non-periodic radial profile ~~(107)~~.

9. (Currently Amended) ~~An~~ The optical scanning device according to claim 8, wherein said non-periodic phase structure is combined with said diffraction structure ~~(48)~~.

10. (Currently Amended) ~~An~~ The optical scanning device according to claim 1, wherein the selected diffraction order m_1 for the first radiation beam is a positive order, the selected diffraction order m_2 for the second radiation beam is a zeroth order and the selected diffraction order m_3 for the third radiation beam is a negative order.

11. (Currently Amended) ~~An~~ The optical scanning device according to claim 1, wherein each radiation beam has a predetermined wavelength ~~(λ_1 ; λ_2 ; λ_3)~~, wherein the wavelength of said third radiation beam is shorter than the wavelength of said second radiation beam and the wavelength of said second radiation beam is shorter than said first radiation beam.

12. (Currently Amended) ~~An~~ The optical scanning device according to claim 11, wherein said predetermined wavelength of said first, second and third radiation beam is approximately 785, 650 and 405 nanometres, respectively.

13. (Currently Amended) ~~An~~ The optical scanning device according to claim 1, wherein said first, second and third information layer depths d_1 , d_2 , d_3 are approximately 1.2, 0.6 and 0.1 ~~millimetres~~ millimeters, respectively.

14. (Withdrawn-Currently Amended) An optical system for introducing first, second and third, different, wavefront modifications into at least part of first, second and third, radiation beams ~~($4'$; $4''$; $4'''$)~~, respectively,

each said radiation beam having a different predetermined wavelength ~~(λ_1 ; λ_2 ; λ_3)~~, the wavelength of said third radiation beam being shorter than the wavelength of both said first and said second radiation beam,

wherein said optical system comprises a diffraction structure ~~(48)~~ having a profile which varies in steps which are arranged to provide selected diffraction components in said wavefront modifications, the selected diffraction component of said first wavefront modification being a diffraction component of a non-zero

order,

~~characterised in that:~~

i) ~~wherein~~ the diffraction structure is arranged such that the selected diffraction component of said third wavefront

modification is a diffraction component of a non-zero order;

wherein at least one of the selected diffraction orders is negative; and ~~in that~~

ii) ~~wherein~~ the steps of the profile of the diffraction structure are arranged to introduce into said second radiation beam phase changes, each phase change, modulo 2π , being substantially equal to each other phase change.

15. (Withdrawn-Currently Amended) ~~An~~ The optical system according to claim 14, wherein said system includes a lens (32) for focusing each of said first, second and third radiation beams ~~(4', 4'', 4''')~~.

16. (Withdrawn-Currently Amended) ~~An~~ The optical system according to claim 14, wherein said optical system has an optical

axis ~~(OA)~~ and said diffraction structure ~~(48)~~ comprises a plurality of annular protrusions ~~(50)~~ arranged concentrically about said optical axis.

17. (Withdrawn-Currently Amended) ~~An~~ The optical system according to claim 16, wherein each said protrusion ~~(50)~~ has a stepped profile, each protrusion including a plurality of steps ~~(52; 54; 56)~~ having different heights ~~(h_1 ; h_2 ; h_3)~~.

18. (Currently Amended) ~~An~~ The optical ~~system~~ scanning device according to claim 1, wherein each wavefront modification includes a non-diffraction adaptation component and said optical system comprises an adaptation structure ~~(40)~~ arranged to provide said adaptation component, wherein said adaptation component is arranged to introduce spherical aberration.

19. (Currently Amended) ~~An~~ The optical ~~system~~ scanning device according to claim 18, wherein said adaptation structure ~~(40)~~ provides a face ~~(46)~~ which is substantially aspherical.

20. (Currently Amended) ~~An~~ The optical ~~system scanning device~~ according to claim 18, wherein said diffraction structure ~~(48)~~ is combined with said adaptation structure ~~(40)~~.

21. (Currently Amended) An optical system according to ~~claim 1~~ claim 14, wherein each wavefront modification includes a non-periodic phase component and said optical system comprises a non-periodic phase structure arranged to provide said non-periodic phase component, wherein said non-periodic phase structure comprises a plurality of radial zones ~~(114; 116; 118)~~ arranged concentrically about said optical axis ~~(OA)~~ and having a non-periodic radial profile ~~(107)~~.

22. (Currently Amended) ~~An~~ The optical system according to claim 21, wherein said non-periodic phase structure is combined with said diffraction structure ~~(48)~~.

23. (Currently Amended) ~~An~~ The optical system according to

~~claim 1~~ claim 14, wherein said diffraction component of said first wavefront modification is a diffraction component of a positive order and said diffraction component of said third wavefront modification is a diffraction component of a negative order.

24. (Currently Amended) ~~An~~ The optical system according to ~~claim 1~~ claim 14, wherein the wavelength of said second radiation beam is shorter than the wavelength of said first radiation beam.

25. (Currently Amended) ~~An~~ The optical system according to claim 24, wherein said predetermined wavelength of said first, second and third radiation beam is approximately 785, 650 and 405 nanometres, respectively.

26. (Withdrawn-Currently Amended) An optical scanning device for scanning a first, second and third, different, optical record carrier ~~(3', 3'', 3''')~~ with a first, second and third, different, radiation beam ~~(4', 4'', 4''')~~, respectively,
each radiation beam having a different predetermined

wavelength ~~(λ_1 ; λ_2 ; λ_3)~~, the wavelength of said third radiation beam being shorter than the wavelength of both said first and said second radiation beam,

said optical scanning device comprising an optical system (8) according to claim 14.

27. (Currently Amended) ~~An~~ The optical scanning device according to claim 13, wherein the optical system is arranged to focus said first, second and third radiation beams ~~(4'; 4''; 4''')~~ to a desired focal point on said first, second and third optical record carriers ~~(3'; 3''; 3''')~~, respectively.

28. (Withdrawn-Currently Amended) ~~An~~ The optical scanning device according to claim 26, wherein each of said first, second and third optical record carriers ~~(3'; 3''; 3''')~~ have an information layer at first, second and third information layer depths d_1 , d_2 , d_3 , of approximately 1.2, 0.6 and 0.1 ~~millimetres~~ millimeters, respectively.

29. (Currently Amended) An optical system for introducing first, second and third, different, wavefront modifications into at least part of first, second and third, radiation beams ~~(4'; 4''; 4''')~~, respectively,

each said radiation beam having a different predetermined wavelength ~~(λ_1 ; λ_2 ; λ_3)~~, the wavelength of said third radiation beam being shorter than the wavelength of both said first and said second radiation beam,

wherein said optical system comprises a diffraction structure ~~(48)~~ having a profile which varies in steps which are arranged to provide selected diffraction components in said wavefront modifications, the selected diffraction component of said first wavefront modification being a diffraction component of a non-zero order,

~~characterised in that:~~

i) wherein the diffraction structure is arranged such that the selected diffraction component of said third wavefront modification is a diffraction component of a non-zero order;

wherein at least one of the selected diffraction orders is

negative, and in that

ii) wherein the steps of the profile of the diffraction structure are arranged such that the selected diffraction component of said second wavefront modification is a diffraction component of a zero order.